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Monthly Variation of Physico-chemical Characteristics of Wullar Lake, Srinagar, Kashmir

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ABSTRACT

The study was undertaken to assess variation in water quality with time of Wullar lake. Five sampling points were selected along the lake for sampling purpose from July, 2004 to December, 2008. Water samples were analyzed in terms of physico-chemical water quality parameters. The overall average value of were found as temperature (18.8±0.93°C), pH (7.44±0.19), turbidity (24.62±3.73 NTU), DO (4.3±1.28 mg/l), COD (22.81±9.59 mg/l), alkalinity (82.37±11.65 mg/l), total hardness (137.57±14.75 mg/l), Ca (34.02±9.33 mg/l), Mg (18.89±4.23 mg/l), chloride (20.81±1.18 mg/l), ammonium nitrate (0.93±0.45 mg/l), phosphate (1.00±0.83 mg/l) and sodium (3.75±0.89 mg/l). The values of these parameters indicate that Wullar lake is moderately polluted under the study area.

Keywords: Water quality; Wullar lake, Srinagar.

INTRODUCTION

Water quality degradation by various sources becomes an important issue around the world. Usage of more land for agricultural purposes, soil salinization, and increase in the use of agricultural fertilizers, common pesticide use, and erosion have become problems threatening natural water source (Zalids *et al*.,2002).

The urban aquatic ecosystems are strongly influenced by long term discharge of untreated domestic and industrial wastewaters, storm water runoff, accidental spills and direct solid waste dumping (Sarika and Chandramohankumar, 2008). Generally speaking, water pollution is a state of deviation from pure condition, where by its normal functioning and properties are affected. Aggravated environmental problems

often reflected the misuse or misunderstanding of technology (Petak, 1980).

Wullar lake is the India's Largest fresh water lake is located in Bandipore district in the Indian state of Jammu & Kashmir. It is also one of the largest fresh water lakes in Asia. The lake basin was formed as a result of tectonic activity and is fed by the Jhelum river. The lake size varies from 12 to 100 square miles (30 to 260 square kilometers) depending upon the season. The maximum depth of the lake is 14^{th} meters with the surface elevation 1580 meter and maximum length is 16 km and max width is 9.6 km. The lake is surrounded by hills in the north eastern and north western sides and is subjected to the action of sudden and furious hurricanes that sweep over it with extra ordinary violence. Besides the runoff from catchment, the lake also receives water from Madhumati stream, Erin Nallah and river Jhelum etc. River Jhelum the main river of the valley flows into the the wuller on its east sides near the middle of the lake, leaving it at south west corner in a fine open stream about 200 years wide. Apart from river Jhelum which pores into the lake, the lake commands a large catchment area of 33- 615 thousand hacters which drains into the lake chiefly through Madhumati, and Haritar Nallah (3153 hc) in its north and Ferozpora and Haritar nallah in the south and Nilgli nallah falls directly into outfalls channels both of which are monitored. The other rivulets, nallah also contribute to Wuller Lake. Due to increase in anthropogenic pressure in their catchments areas the lakes are becoming the victims of cultural eutrophification (Zutshi *et al.*; 1980, Pandit, 1996). A considerable amount of work has been carried out on different aspects of hydrobiology of the Himalayan lakes (Das *et al*., 1969; Zutshi *et al*., 1972; Pant *et al*., 1985; Zutshi, 1989; Khulbe, 1992; Rawat *et al*., 1993; Jana, 1998; Jain *et al*., 1999). Considerable hydrobiological investigations have been carried out on the water bodies in other parts of India (Abbasi *et al*., 1996; Shastri and Pendse, 2001). The current study was designed to obtain the present water quality profile and eco-conservation of the Wullar Lake. The physical and chemical limnology of a lake is characterized by hydrologic impact, autogenic nutrient dynamics and biological aspects. These factors combine with each other determine the water quality and consequently community of lake (Sidneit *et al*., 1992). The increased demand of water as a consequence of population growth, agriculture and industrial development has forced environmentalist to determine the chemical, physical and biological characteristics of natural water resources (Regina and Nabi, 2003). To study the extent of pollution in surface water we have selected the Wullar Lake, which is subjected to enormous anthropogenic stresses; receive heavy inputs of domestic waste and sewage. The overall objective of this study is to evaluate the physico-chemical characteristics of lake water.

MATERIALS AND METHODS

Wullar lake is located between longitude 34^0 20'N of latitude and 74^0 36'E of longitude. In the present investigation, five sampling stations (WL1, WL2, WL3, WL4 and WL5) were selected for the collection of fortnightly water samples during the period of July to December, 2008. Sampling station-1 (WL1) is the Jhelum

entry point located at south western part of the lake receiving the sewage effluents through the river Jhelum. Sampling station-2 (WL2) is located in the middle of the northern region, sampling station-3 (WL3) is Earn Nallah , located at the southern region, sampling station-4 (WL4), is Kani Bhatt located at east western regions and sampling station-5 (WL5), is located at western region receiving the natural runoff through the hills. The water samples were analyzed immediately for parameters, which need to be determined instantly and rest of samples were refrigerated at 40^0C to be analyzed later (Sharma et al., 2010). For the estimation of DO and BOD, water samples were fixed at the sites. Physico-chemical analysis of water was carried out referring the 'standard methods 2002'.

The simple linear correlation analysis has been carried out to find out correlation between any two tested parameters. The significance of correlation was also tested.

RESULTS AND DISCUSSION

Temperature and photoperiod are important factors which control the behavior, physiology and distribution of organism (Srivastav et al., 2009). The average values of water temperature at all five sites were ranged between $25.2+1.52^0$C (July) and $10.4 +0.84^0$C (Dec.). Temperature was found negatively correlated with DO (Das, 2000) and positively correlated with turbidity (Pradhan et al., 2003). Temperature also represents a positive correlation with BOD and COD.

pH regulates most of the biological processes and biochemical reactions. In the present study pH is negatively correlated with temperature. The average pH values at all five sites were found to be ranged between 7.52±0.26 (July) to 7.544±0.15 (Dec.).

Water Transparency is an important factor that controls the energy relationship at different trophic levels. It is essentially a function of reflection of light from the surface and is influenced by the absorption characteristics of both water and of its dissolved and particulate matter (Stepane et al., 1959). *Turbidity* is positively correlated with temperature. The range of turbidity variation was found between 21.33±0.84 NTU (Dec.) and 28.35±5.57 NTU (July) at all the sites.

Dissolved Oxygen is negatively correlated with temperature. Low temperature in winter contributed rise in DO concentration while in summer season DO concentration decreases due to high temperature and more oxygen utilization. It has been reported that lower values of dissolved oxygen in summer months due to higher rate of decomposition of organic matter and limited flow of water in low oxygen holding environment due to high temperature (Rani and Shrivastava, 2004). There is an inverse relation between DO and oxygen utilization in terms of BOD and COD. The average values of DO at all five sites were varied from 2.34±1.89 mg/l (July) to 5.89±1.29 mg/l (Dec.).

Chemical Oxygen Demand is an oxygen demand to decompose the biodegradable as well as non biodegradable organic waste. COD represents a positive correlation with temperature and inverse relation with DO. However, the increase in COD during hot period is mainly attributed to the increase in the air and water temperatures, facilitating

the decomposition and oxidation of organic matter (Abdo, 2002). The average values of COD at all five sites were found to be ranging from 17.36±9.73 mg/l (Dec.) to 27.68±5.76 mg/l (July).

Quantitative analytical results of alkalinity, total hardness, calcium and magnesium, shows higher concentration at extreme temperature. Wullar lake water exhibit, slightly alkaline character due to continuous sewage disposal and improper decomposition of organic waste. Notable increasing trend is observed in calcium and magnesium in summer season due to increase in ionic concentration and movement (Sharma and Sharma, 2010).

Total alkalinity is due to salts of weak acids and bicarbonates to highly alkaline water is unportable (Mahadev *et al*., 2010). High values of total alkalinity may be attributed to the increase in organic decomposition during which CO2 is liberated (Bharathi *et al*., 1973). This reacts to form bicarbonate thereby increasing total alkalinity in summer. The average value of alkalinity observed in the range between 77±10.34mg/l (Dec.) to 90.4±7.23mg/l (July) at all the five sites. Hardness mainly causes from cations and of Ca++, Mg++, Sr++, Fe++ [14]. Average value of total hardness were detected 128.2±11.12mg/l (Dec.) to 149±26.91mg/l (July) at all five sites. It was reported that total hardness was high during summer than monsoon and winter. High value of hardness during summer can be attributed to decrease in water volume and increase of rate of evaporation of water (Huzare, 2008). Calcium hardness and magnesium in its average value were recorded to be ranging between 30.156±10.06 (Dec.) to 36.236±5.37 (July) and 15.57±3.09 (Dec.) to 21.78±2.55 (July) in all the five sites. Generally, the calcium content in the water is affected by the adsorption of the calcium ion on the metallic oxides (Wilson, 1975).

Table No-1: Average value of monthly variation in Physico-Chemical characteristics of Wullar Lake water at all five sites

Parameters	July	Aug	Sep	Oct	Nov	Dec	Over all
Temp	25.2±1.52	20.8±0.84	19.7±0.55	19.1±0.84	18±1.00	10.4±0.84	18.87±0.93
pH	7.52±0.19	7.408±0.21	7.288±0.26	7.243±0.17	7.621±0.17	7.544±0.15	7.44±0.19
Turbidity (NTU)	28.35±5.57	26.56±7.36	24.55±0.55	24.12±7.09	22.78±1.00	21.33±0.84	24.62±3.73
D.O(mg/l)	2.34±1.89	2.56±1.13	4.45±1.02	4.98±1.20	5.64±1.17	5.89±1.29	4.3±1.28
COD(mg/l)	27.68±5.76	27.58±8.50	27.562±10.89	19.38±11.88	17.34±10.76	17.36±9.73	22.81±9.59
Alkanity (mg/l)	90.4±7.23	82.6±15.96	83±13.45	81.8±11.80	79.4±11.08	77±10.34	82.37±11.65
TH (mg/l)	149±26.91	141.8±9.60	139.2±15.14	135.8±13.39	131.4±12.34	128.2±11.12	137.57±14.75
Ca (mg/l)	36.236±5.37	37.091±8.13	34.567±9.82	33.876±10.54	32.167±12.05	30.156±10.06	34.02±9.33
Mg (mg/l)	21.78±2.55	20.56±3.52	19.7±2.67	17.87±11.43	16.87±2.12	15.57±3.09	18.89±4.23
Cl (mg/l)	24.24±1.14	23.14±1.14	20.67±1.52	20.76±1.52	19.67±1.30	16.4±0.44	20.81±1.18
Amm.Nitrate	0.776±0.40	0.816±0.54	0.808±0.25	0.584±0.55	1.528±0.36	1.0632±0.58	0.93±0.45
Phosphate(m/l)	1.0264±1.50	0.81±0.96	0.672±0.25	0.902±0.59	1.754±0.87	0.8328±0.81	1.00±0.83
Sodium(mg/l)	4.6±1.30	4.2±0.55	4±1.22	3.7±1.10	3.1±0.55	2.9±0.64	3.75±0.89

Chlorides occur naturally in all types of water. High concentration of chloride is considered to be the indicators of pollution due to organic wastes of animal or industrial origin. Chlorides are troublesome in irrigation water and also harmful to aquatic life (Rajkumar *et al*., 2004). The levels of chloride in the present study were ranging with an average value of 16.4±0.44 mg/l (Dec.) to 24.2416.4±0.44 mg/l 1.14 mg/l (July).

Ammonium Sulphate were ranged between 0.584±0.55 mg/l (Oct.) to 1.528±0.36 mg/l

(Nov.) and *Phosphate* were detected between 0.672±0.25 mg/l (Sep.) to 1.754±0.87 mg/l (Nov.). *Sodium* was observed between in the range of 2.9±0.64 mg/l (Dec.) to 4.6±1.30 mg/l (July).

The average values of monthly variation in physicochemical parameters of water collected from different sites of the lake are shown in table-1 and their correlation in table-2.

Table No-2: Correlation of average value of monthly variation in Physico-Chemical characteristics of Wullar Lake water at all five sites

	Temp	pH	Tur-bidity	D.O	COD	Alka-nity	TH	Ca	Mg	Cl	Amm. Nitrate	Phos-phate	Na
Temp	1.000												
pH	-0.211	1.000											
Turbidity	0.924	-0.173	1.000										
D.O	-0.816	0.131	-0.967	1.000									
COD	0.736	-0.344	0.846	-0.876	1.000								
Alkanity	0.909	-0.130	0.934	-0.835	0.755	1.000							
TH	0.918	-0.215	0.988	-0.942	0.880	0.962	1.000						
Ca	0.880	-0.369	0.933	-0.934	0.878	0.775	0.906	1.000					
Mg	0.929	-0.483	0.978	-0.951	0.943	0.913	0.986	0.958	1.000				
Cl	0.967	-0.210	0.933	-0.921	0.791	0.881	0.943	0.956	0.960	1.000			
Amm. Nitrate	-0.378	0.806	-0.513	0.499	-0.534	-0.484	-0.547	-0.549	-0.723	-0.445	1.000		
Phosphate	0.028	0.675	-0.210	0.306	-0.506	-0.151	-0.272	-0.290	-0.329	-0.079	0.812	1.000	
Na	0.899	-0.368	0.971	-0.935	0.915	0.918	0.985	0.941	0.996	0.935	-0.645	-0.386	1.000

CONCLOSION

The study concludes that the water quality of Wullar lake is polluted as the results are above the permissible limits. The city sewage discharge, agriculture and urban runoff and continuous dumping of waste materials especially sanitary waste through various nallas are affecting the water quality of this urban water body.

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